

Public Health Pesticide Applicator Training Manual

MITES & TICKS

The order Acarina (class Arachnida) includes mites and ticks. Members of this order differ from other arachnids in that the body is not segmented, and the cephalothorax and abdomen are combined into one body region. Larval mites and ticks have three pairs of legs, whereas nymphs and adults have four pairs. Mites inhabit most ecological settings, ranging from deserts to rain forests, mountain tops to tundra, saltwater ocean floors to freshwater lakes. The relatively few species parasitic on humans in the United States produce dermatitis, often followed by allergic reactions.

Ticks are parasitic during some stage of their life cycle. They are annoying pests whose bites are irritating and, when forcibly removed, the mouthparts frequently remain in the skin, resulting in a sore, an infection or even blood-poisoning. In the United States ticks, unlike mites, transmit many serious diseases.

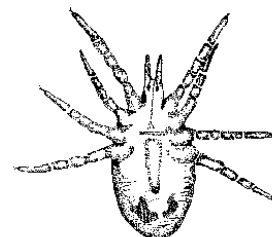
I. MITES

Mites attacking humans with some frequency in the United States originate in a variety of habitats. Some migrate to man from birds, including the chicken mite and the tropical fowl mite. Others, such as grain mites and mushroom mites, are found in food materials or stored products. The straw itch mite and furniture mite come from plant material and the chigger mite is found in lawns and open woodlands. From rodents come the tropical rat mite and the mouse mite, whereas the itch mite and follicle mite are permanent residents on man. Mites exhibit the gradual metamorphosis typical of arthropods other than insects.

Bionomics

Chicken mite (*Dermanyssus gallinae*). Best known of the mites infesting poultry, the chicken mite is found on the birds only when it is feeding, which is normally at night. In the daytime it hides in cracks and crevices in the vicinity of the roost. The chicken mite will feed freely on many other birds, including pigeons, canaries, sparrows, swallows, doves and wrens. When the mite attacks man it causes a mild dermatitis and itching. Cases of dermatitis caused by this mite undoubtedly are common in rural areas but infestations also occur in urban areas. These include instances where the infestations can be traced to pet canaries, pigeons and nests of other wild birds or in which death of the bird host or its departure from the nest instigated the attack on man. It is believed that this species can live for several months without food.

Northern fowl mite (*Ornithonyssus sylvarium*). Although very similar to the chicken mite in appearance, the northern fowl mite differs in that it breeds among the feathers of the host and may complete development without leaving the host. It is not necessary for this mite to stay on the host, however, and they may be found in nests, or roost areas, and in surrounding cracks and crevices. They can survive for two or three weeks away from the host. This mite may bite man, causing some annoyance but infrequently dermatitis. The problem most frequently is irritation from the occasional bites inflicted by wandering mites. The mite is a general parasite of birds, being found on domestic fowl, sparrows, swallows and many other avian species throughout the temperate region. Human annoyance is frequently associated with the absence of the normal host bird, leaving an infestation of mites in the nest area without a convenient source of food.



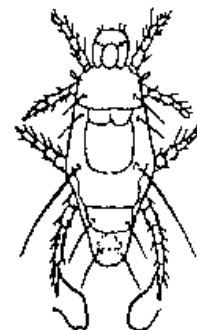
Tropical rat mite (*Ornithonyssus bacoti*). This mite is associated with rats throughout the United States, where it feeds also on man and many other warm-blooded animals. The bite is painful, causing intense itching and a skin irritation known as rat-mite dermatitis. The mite has not been proven to be a transmitter of typhus or other diseases, although its habits appear to suit it well for such a role. Attacks on man are almost always associated with rats in buildings and complaints are common from areas which may be infested with rats, such as warehouses, stores, theaters, and apartments. Rat control may intensify the attack on man, but this mite will bite man even where there is an abundance of host rats on which they can feed. The mites drop from their host after each feeding and may be found on a variety of surfaces near rat-infested areas. They can survive for several days without a blood meal.

House mouse mite (*Liponissoides sanguineus*). This mite in the United States is primarily a parasite of mice. It tends to leave its rodent host to wander throughout buildings and bite man. Its major importance is that it has been identified as the vector of rickettsial pox, a mild and nonfatal disease of man.

Grain mites. Grain mites (including the furniture mite and the mushroom mite) are commonly found infesting all types of grain flour, stored foods, cheese and mushroom beds. They prefer a moist location and under favorable conditions develop rapidly and in great numbers, completing the cycle in as little as 17 days. Under adverse conditions this period may be considerably extended. In some species the second nymphal form may be replaced by a special stage known as the “hypopus”, which is highly resistant to unfavorable conditions, insecticides and fumigation and may exist for several months without feeding. The hypopus is transported from place to place by clinging to small animal forms such as insects or mice. When it encounters favorable conditions it sheds its skin and resumes normal growth and development. The peculiar adaptation through the hypopus stage makes control very difficult.

Grain mites are reported to have been the cause of mild dermatitis in man, known under various names as “grocers’ itch,” “vanillism” (from infestations on vanilla beans), and “copra itch.” These cases are reported where products infested with the mites are handled by man. These mites are not blood-sucking forms and thus are the cause of only mild irritations, very easily remedied once the source of exposure is identified.

Straw itch mite (*Pyemotes ventricosus*). The straw itch mite normally lives on other arthropods. Common hosts are the larvae of several insects such as the wheat jointworm; the wheat straw-worm; the Angoumois grain moth; the rice, granary, bean and pea weevils, and the pink boll worm. It reproduces rapidly and in enormous numbers. This mite has an unusual development in which the eggs hatch and the young are matured within the body of the female. They are released as sexually mature adults. It is reported that a single female may give birth to over 200 adult mites and that in one week the females of this brood will have produced another brood in the same manner. Homes with beetle-infested beans or cereals in cupboards often have problems with this mite. *Pyemotes* causes severe bite reactions.

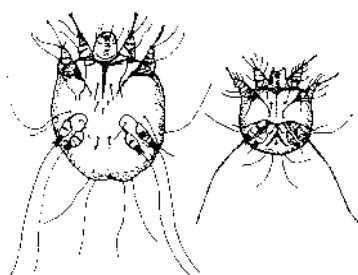


Men engaged in threshing straw or handling grains or other material infested with the insect hosts often are overrun by these mites. Their bites produce a rash-like dermatitis which may cover large areas of the body. The rash appears about 12 hours after the attack and is accompanied by severe itching. The attack is often of such intensity as to induce vomiting, headache, sweating and fever.



Chiggers (*Eutrombicula alfreddugesi*). Larvae of chiggers or red bugs attack man and dogs during the larval stage. These mites are distributed over approximately the eastern half of the country. They are most common in the southern states where breeding may be continuous, but frequently are abundant during the summer in the more northern states with one to three generations per year. They infest a variety of areas ranging from those overgrown brush to well-kept lawns. Adults overwinter in earthen cells in the soil, scavenge on decaying matter, and emerge from the soil in the Spring to lay their eggs. These hatch into tiny oval orange-colored larvae that normally feed on snakes, turtles, rabbits, birds and other wildlife. These larvae, barely visible to the naked eye, are very active. When humans come in contact with infested vegetation, the larvae swarm over the entire body and it might be several hours before they settle down to feed. Their attack seems to be concentrated at points where the clothing is pressed against the skin, as under belts or garters.

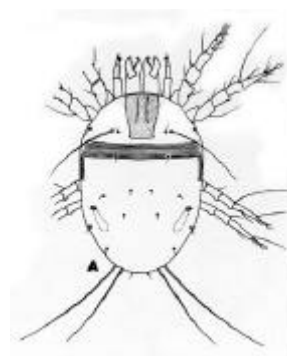
They attach, frequently near a hair follicle, by their mouthparts and first pair of appendages. The mite injects a fluid that liquefies the immediately adjacent tissues, which are then ingested. The surrounding tissues become hardened and, as feeding progresses, form a tiny tube through which further liquified tissue may be withdrawn. The larva becomes fully fed in four to six days when it drops off the host, leaving behind the tube which it has developed from the feeding activity. The digestive fluid of the mite causes a severe itching and a definite dermatitis. Itching may last for a week or more. Scratching these areas may lead to secondary infection. After leaving the host, the larva transforms to a nymph and later to the adult. Neither of these forms attack man or other animals, but feed on vegetable matter. This mite is not associated with disease transmission in the United States.



Itch mite (*Sarcoptes scabiei*). This mite causes scabies or itch in man and is parasitic on dogs, pigs, horses and sheep. There are several closely related forms on animals that may sometimes transfer to man, but usually close contact is required. Favored sites are in the skin between the fingers, the folds at the wrists, at the bend of the elbow or knee and under breasts. Crowded conditions encourage the spread of scabies infestations. The female mite cuts into the skin, makes a burrow under the skin and lays eggs. The larvae return to the surface of the skin to molt and the nymphal and adult stages are then spent on the surface. Unnoticed at first in newly infested people, sensitivity and itching builds up at the end of the first month of infestation.

Follicle mite (*Demodex folliculorum*). This mite is found in the skin pores of humans, especially around the nose and eyelids. It is likely that most people harbor this species. The mite is entirely parasitic, spending the entire life cycle on the host.

House dust mite (*Dermatophagoides* spp.). House dust mites can be a problem in any building that people occupy on a regular basis. They are generally found in mattresses, pillows, overstuffed furniture, rugs, floors or other protected places where people sleep or sit for long periods. They require a damp environment and are often found in floors where moist air may enter a room. Eggs are laid singly and the life cycle takes about a month. Adults live for one to three months, feeding on a variety of foods, including dog food, cereals, yeast and especially the scaling of the skin of humans and their pets. In some sensitive persons, they cause an allergic reaction.



Detection & Control

Detection. Survey methods vary with the habits of the species being investigated. Various household ectoparasites can generally be found in structures.

To survey for chigger mites, use 12-inch squares of black or white paper placed on the ground for one to five minutes at intervals of 100 feet, perhaps, throughout the area, or in 400 x 400 ft grids. Count and record the number of mites aggregating at the upper edge of the squares. Collect the mites with a fine pointed brush and vials of alcohol for later identification.

Use Berlese funnels to collect flour and grain mites and other free-ranging species, such as bird mites in nesting material.

Estimates of chigger, bird and rodent mite population densities can be based on data gathered by stunning or killing the ectoparasites (with ether or chloroform) on dead or trapped animals, and combing (or beating) the parasites into a white enameled pan, or picking them off with forceps. Alternatively, live hosts in cages with hardware cloth bottoms can be placed so that mites will drop into a pan of water after engorging, or the ectoparasites can be floated from a dead animal by immersion in water containing detergent, and then collected on filter paper.

Scabies mites are detected by making skin scrapings for microscopic examination.

Control. Do not attempt control for the scabies (human itch) mite. This pest is controlled by laundering bedding and underwear and use of pesticide ointments prescribed by a physician. These may be recommended for application from the neck down for all family members.

For mites that migrate from bird nests or coops, remove the nests or caulk to exclude mite movement into dwellings. Wear protective clothing (gloves, eyeglasses, etc.) to prevent mites and nest debris from contaminating workers. Apply approved pesticide sprays or dusts indoors to cracks and crevices near or leading to mite sources, and outside at nest areas. Habitat alteration to remove birds from nest areas coupled with pesticide application should immediately (one day) eliminate the problem.

For chigger mites, avoid infested locations or use repellents (deet and/or permethrin) on pants legs and shoes and tuck trousers into boots. When possible, keep vegetation cut low. Not only does this remove chigger harborage, it also eliminates harborage for rodents and other animals that serve as wild hosts. These sanitation practices are especially important for chigger management in fields, vacant lots, recreational areas and parks. Chiggers can also be controlled in lawns and other infested areas by careful

and thorough treatment with granules or sprays of residual pesticides that are effective against mites. The miticides will work best if applied after the infested area has been mowed.

II. TICKS

From a public health standpoint ticks are important as vectors of diseases of humans and other animals. Many species are quite resistant to environmental stresses and may live for many years. They have few natural enemies and have a wide range of hosts. Ticks typically take one blood meal in each of the three parasitic stages, larva, nymph and adult. Both sexes are blood feeders, the female becoming greatly distended with blood after mating and then producing many eggs. Most ticks feed on a different host during each parasitic stage. Ticks attach themselves to some people, whereas others are seldom or never bitten. After exposure to ticks, the body should be carefully searched, including the scalp.

Several characteristics of ticks make them outstanding vectors of pathogenic agents. Wide host range and tendency to feed on several hosts during their lifetime ensures ample opportunity to acquire and transmit pathogens. Hardiness and longevity allow them to survive periods of unfavorable environmental conditions. High reproductive potential ensures large populations and a high frequency of host-vector contact. Finally, they feed slowly and attach to the host for relatively long periods. This allows sufficient time for pathogen acquisition and transmission as well as vector dispersal by means of host movement.

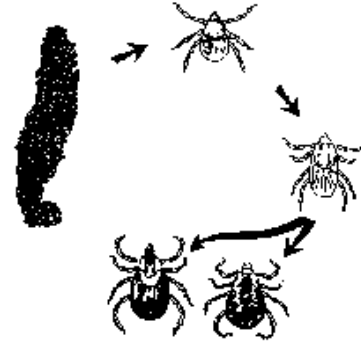
Hard ticks (family Ixodidae) are responsible for transmission of the majority of tick-borne diseases of humans in the United States. They are the vectors of babesiosis, Colorado tick fever, Lyme disease, Rocky Mountain spotted fever, and tularemia. While soft ticks (family Argasidae) do not directly transmit these diseases to man, they may be involved in the maintenance of natural cycles among reservoir hosts, as in the case of Colorado tick fever. In addition, soft ticks of the genus *Ornithodoros* are the vectors of tick-borne relapsing fever.

Hard ticks have a hard upper surface called a shield or scutellum that covers the entire back of the male, but only partly covers the female. Mouthparts are visible from above. They attach securely and may feed for weeks, using a different host in each life stage. The female produces as many as 6000 to 7000 eggs.

Soft ticks do not possess a shield, so the sexes look alike. Their mouthparts are beneath the anterior end of the body and are not visible from above. Principal hosts are birds, domestic animals, bats and small mammals. These ticks feed intermittently at night. The female oviposits following the blood meal and produces 500 to 1000 eggs during her lifetime.

Developmental Stages

Seed tick. Normally, thousands of tiny larvae hatch from an egg batch and crawl randomly in search of a host. Fortunate ones attach to a small mammal or lizard. Feeding time is generally short, a few hours or a day, but up to three days for *Ixodes scapularis*. During feeding the host wanders and the tick is transported to a new location where, when engorged, it drops off.



Nymph. After molting, hard tick nymphs climb grass leaves or plant stems and quest. Because they are higher than ground level, they tend to attach to larger hosts than before. Soft tick nymphs burrow in and await the arrival of a host. After several days of feeding they drop off and again molt.

Adult. Ticks sometimes wait for months or more than a year for a suitable host. When finally engorged, they drop off to oviposit. Ticks that tend to feed on the same host species at each stage are referred to as 1-host ticks, whereas those that feed on different hosts each time are called 3-host ticks.

Bionomics

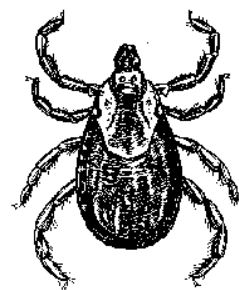
Hard ticks and some species of soft ticks seek their hosts by climbing vegetation and awaiting vibrations or shadows to announce the arrival of a host. The first pair of legs is extended and used to grasp the host when contact is made. This behavior is known as questing. If heat or carbon dioxide is detected by the tick, it will seek it out and climb onto the host as it passes. The height at which questing takes place determines the size of the host and therefore, to some extent, the species selected. There is considerable variation between species, and the different life stages of some species, in the height at which they quest.

Many soft ticks, in contrast, inhabit caves, dens, stables, and other places used by potential hosts. They typically secrete themselves in loose soil or cracks and crevices by day and attack their host at night, usually while it is asleep. They crawl to the host, engorge in a few minutes or hours, and return to their hiding place.

All ticks orient to potential hosts in response to products of respiration. Carbon dioxide, in particular, is attractive at a distance. This characteristic is helpful in surveillance studies because many species can be collected using traps baited with dry ice.

When feeding, the tick uses its chelicerae (teeth) to cut the victim's skin and then inserts its mouthparts. The hypostome (feeding tube) has many rows of recurved barbs that become cemented in and anchor the tick to its host (making it very hard to withdraw by external force). Blood is pumped by a muscular pharynx (pump) and the salivary glands produce an anticoagulant that allows long periods of feeding without the host blood coagulating. The tick usually moves to the highest part of the host to attach and feed on the head or ears.

American dog tick (*Dermacentor variabilis*). The American dog tick, a 3-host tick, is widely distributed east of the Rocky Mountains and along the Pacific coast. Dogs are the preferred host of adult ticks, although they feed readily on many large mammals including humans. This tick species transmits the causative pathogen of Rocky Mountain spotted fever and possibly Q fever to humans. Adult ticks are commonly found in Spring on grass and other low vegetation in their questing position. The adult stage is identified by the ornate pattern (i.e., pale markings) on the scutum. Also, they have eleven festoons, simple eyes, and short mouthparts.



American dog ticks prefer overgrown urban and rural vacant lots, wood-lined creeks, waste farm fields, weedy roadsides and edges of paths and hiking trails. They wait on grass and weeds for a suitable host to brush against the vegetation, and are commonly encountered by sportsmen and recreationalists. Larval activity begins in early Spring when they feed on rodents such as meadow voles and white footed mice, whereas the eight-legged nymphs may be found on white-footed mice, cotton rats, and rabbits during winter months. Adults are most abundant from mid-April to mid-July. Once on the host, they crawl upward, seeking a place to attach and take a bloodmeal. The adult male may remain on the host for an indefinite period of time, alternately feeding and mating. The female feeds, mates, becomes engorged, and drops off to lay several thousand eggs. The entire life cycle requires from four months to more than a year.



Brown dog tick (*Rhipicephalus sanguineus*). The brown dog tick creates severe annoyance when it infests domestic pets and becomes established inside buildings. This tick, the most widely distributed tick in the United States, is a characteristically reddish-brown species that attacks dogs, and other mammals, but rarely humans. It is not known to transmit human diseases. Normally a parasite of dogs, it attaches to the ears and in between the toes of dogs. The engorged female ticks, sometimes about a half inch long, are particularly noticeable as they crawl on walls, window frames, or around baseboards and

cracks, looking for protected areas in which to deposit their 1,000 to 3,000 eggs. The entire life cycle can be completed in less than two months. Homes and yards can become heavily infested after the passing of a single dog that drops an engorged females tick with thousands of eggs, eventually reaching a high density in the resident dogs' sleeping areas. This tick does not survive outside in cold climates.

Rocky Mountain wood tick (*Dermacentor andersoni*). The Rocky Mountain wood tick is the major vector of Rocky Mountain spotted fever, a rickettsial disease of man. It is common in the Rocky Mountain states and in southwestern Canada, where it is a vector of bovine anaplasmosis and canine babesiosis (blood parasites of animals). The toxins injected as it feeds cause tick paralysis. Hides punctured by tick feeding are down-graded because of reduced tensile strength.

This tick is a 3-host species. Adult ticks appear in the Spring. They climb on low vegetation along animal trails in pasture or forested areas and attach to passing animals (usually cattle or horses). This tick mates during feeding, after which the female detaches from the host and deposits several thousand eggs over a period of a month. Hatched seed ticks attach to small rodents, feed, detach and develop into the nymphal stage. Nymphs seek shelter and are inactive until the following Spring, when they attach to another animal, feed, drop off and molt into the adult stage. The adult stage overwinters and the following Spring they attach to a large animal, feed and start the life cycle over - the entire procedure requiring three to four years.

Lone star tick (*Amblyomma americanum*). The lone star tick is mainly found in the southeastern sector of the United States, but reaches as far north as New Jersey. Due to its long mouth parts, the bite is quite painful and may itch for a long time. It is a vector of Ehrlichiosis, tick-borne typhus and tularemia. Females of this species are easily recognized by the conspicuous silvery-white spot on the back or scutum. The male tick has horseshoe shaped markings on the posterior region of its reddish-brown body.

All parasitic life stages are commonly encountered by sportsmen and people who work out-of-doors. Nymphal and adult activity begins in March and April, ceasing in August. Larval activity begins about mid-May and subsides in November. Common hosts for all life stages are livestock, dogs, deer, birds and humans. This tick, like many other species, is attracted by the scent of animals, hence is numerous along roads, paths, and trails. Female ticks that drop from animals along bedding areas, pathways, and trails further increase the concentration at these sites.

Deer tick (*Ixodes scapularis*). The deer tick or black legged tick inhabits the eastern two-thirds of the United States, and its close relative, *I. pacificus*, is found on the west coast. These ticks are the main vectors of Lyme disease, human granulocytic ehrlichiosis and babesiosis. Lyme disease signs and

symptoms include a ring-shaped rash at the point of the bite, which usually appears within a few days to a month after the bite. They prefer wooded areas, feeding on a wide variety of birds, mice, deer, domestic animals and man. They are a 3-host tick, the adult reaching only the size of a sesame seed. Overwintering adults produce eggs in the Spring and the larvae feed primarily on white-footed and other mice during the summer. They molt into nymphs the following Spring and feed on larger animals in the woods and grasslands. This is the primary stage that transmits the Lyme disease pathogen to man, following a feeding period of 48 hours or more. Adults feed on deer and other larger mammals.

Relapsing fever ticks (*Ornithodoros* spp.). This is the most important genus of soft ticks from a medical standpoint. Relapsing fever ticks are seldom seen by the average person since they are nest ticks and can survive starvation for months or even years. Persons bitten may contract relapsing fever.

Fowl tick (*Argas persicus*). This soft tick feeds rapidly at night and subsequently oviposits in cracks and crevices. The tick has two or three nymphal stages before molting to the adult stage. Like the relapsing fever tick, these ticks may live for months or years without a blood meal. *Argas persicus* readily attacks humans but does not transmit human disease. It is a vector of fowl spirochaetosis.

Spinose ear tick (*Otobius megnini*). This soft tick gets its name from the habit of larvae and nymphs to infest the ears of cattle, horses, mules, etc., and occasionally people. This is a 1-host tick and all stages feed on the same host.

Rodent tick (*Ornithodoros hermsi*). This soft tick is a common rodent parasite and a vector of relapsing fever. It is found along the Pacific coast and in the Rocky Mountain region of the United States. Larvae can expand to three times their normal size after a blood meal and appear bright red and are sometimes mistakenly referred to as strawberry seed insects.

Detection & Control

Detection. Surveillance for hard ticks is routinely conducted with a tick drag, a soft white cloth (3 X 3 ft) stapled to a dowel to which a cord is attached, and with a second dowel or board at the end to weight the cloth down. Questing ticks grab onto the cloth as it is dragged over grass and brush. The drag is inspected for ticks at fixed intervals, e.g., 10 paces in an area of relatively high tick density or 100 m in less dense infestations. Tick drags are effective when the vegetation is dry and the temperature exceeds 45 degrees F.

For many species, carbon dioxide trapping can yield the most ticks per man-hour expended. This technique relies on the ability of ticks to sense CO₂ and move toward the source. Dry ice is placed in ventilated containers or compressed gas is used as the source of CO₂.

Host trapping, as described above for mite surveillance, is also an effective method for detecting ticks. In areas with dense tick populations, simply walking through the habitat is an effective surveillance method.

Prevention. Personal protection is a recommended approach for prevention of tick bites. Tucking trousers into boots and shirts into pants, using repellent (deet for skin and permethrin for clothing) and performing regular clothing and body checks should be routine when in tick habitat.

Removal of attached, embedded ticks should be done carefully as the insertion is deep and provides an entry for pathogens that might be released if the tick is crushed. The portion of the mouthpart (hypostome) which penetrates the skin, is long in certain ticks and firmly attached and may break off from the body if the tick is forcibly pulled loose. This results in a continuous itching. The inflamed condition is relieved only when the mouthparts are removed. Secondary bacterial infections may occur at the bite site. Do not force the tick to remove itself by placing a chemical or lighted cigarette on it because the tick will respond by regurgitating into the wound before it pulls out. A pair of fine-tipped forceps should be inserted into the skin at the base of the mouthparts and then the entire tick is gently pulled out.

Control. Habitat alteration can be very effective. Exclusion of host animals, e.g., deer, can cause major reductions in populations of ticks that feed on deer. Opening clearings provides better visibility for predators to spot rodents. Keep vegetation short, widen paths and advise users to stay on the paths in order to avoid ticks. Controlled burning and mechanical clearing can reduce infestations temporarily. Reduced cover raises the ground temperature and lowers the humidity, causing the ticks to dry up and die. In addition, when the mice take them to the nest, the parasites are killed without harming the rodents. It eliminates suitable habitat for the larval and nymphal hosts, which includes small rodents such as the white-footed mouse and the meadow vole. Also, limit access of dogs and children to tick habitats. Dog control is important to reduce brown dog tick infestations. Dogs should be disinfested daily.

Approved pesticides can be used in conventional applications in high priority areas. Depending on the target species, spray low vegetation thoroughly, apply granulars in heavier vegetation and dust rodent runs and burrows. Self-treatment stanchions are used to control ticks on deer. Control of ticks on mice in the yard with cardboard cylinders, from which the mice take insecticide impregnated cotton balls to the nest where it kills the parasites without harming the rodents, have not proven to be as effective as initially reported.

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